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Sound insulation of party walls

In a survey of dwellings built during the 1970s, BRE found that over 50 per cent of the party walls failed to achieve the performance standard given in the Building Regulations. To aid selection of a suitable party wall construction, this digest outlines the requirements of the Regulations, and provides information on the performance of some of the more common party wall constructions; it indicates the risk of a wall failing to achieve three levels of performance, the highest of which is the minimum performance requirement of the Building Regulations. The digest draws conclusions about the performance of different constructions and gives examples of features which can adversely affect performance. Whilst specialist knowledge is required to design buildings with very high sound insulation, application of the information given in this digest should contribute to a reduction in the risk of dwellings being built with inadequate performance.

Requirements of Building Regulations

The Building Regulations for England and Wales (1976) and The Building Standards (Scotland) (consolidation) Regulations 1971 incorporate mandatory requirements to limit sound transmission between dwellings. Both Regulations contain two provisions under which constructions are deemed-to-satisfy these requirements. One stipulates the use of one of the construction types specifically described in the Regulations and the other is in the form of a performance standard. To comply with the performance standard in England and Wales it is necessary to supply evidence from tests which demonstrates that the average performance of at least four examples of a construction similar to that proposed satisfies the performance standard. In Scotland, the actual construction is required to meet the performance standard.

Comparison with the performance standard

To assess the performance of a particular design the insulation of four or more examples must be determined at each of the sixteen 1/3 octave bands in the frequency range 100Hz to 3150Hz. An example is shown graphically in Fig 1, in which A represents the reference for party walls between houses and flats in England and Wales. To quantify the performance, the average of the measured values at each frequency is subtracted from the corresponding reference value and the positive results are summed. The sum is called the *Aggregate Adverse Deviation* (AAD) and it must not exceed 23dB to satisfy the performance standard given in the Regulations. The situation is similar in Scotland except that A applies only to walls between houses and B (also shown in Fig 1) must be used to assess walls between flats.

Interpretation of AAD ratings

A recent social survey has provided data which illustrates probable subjective responses to different levels of sound insulation. For example, with party walls complying with the Regulations, about two-and-a-half times as many occupants rated their insulation as very good or good as rated it poor or very poor. At around 48 dB AAD the numbers giving these ratings were approximately equal and at 80 dB AAD about two and a half times as many occupants rated their insulation as poor or very poor as rated it good or very good. The estimated risk of failure to reach these three performance levels for various types of party wall construction is given in Table 1.

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Field performance of common constructions

Table 1 is based on data collected in the course of a BRE survey of physical sound insulation performance between dwellings built since 1970. The conditions for inclusion in the survey and the detailed results have been published in the BRE Current Papers listed under *Further reading*. The survey was carried out non-selectively and the dwellings included were tested as built; they did not necessarily comply with manufacturers recommendations with regard to workmanship and detailing etc.

The first four columns in the Table provide brief descriptions of each of 19 common constructions according to the following definitions:

Solid wall: A single leaf of dense concrete at least 170 mm thick, or of brick or blockwork at least 200 mm thick, or of no-fines concrete at least 225 mm thick. (All thicknesses exclude surface finish).

Cavity wall: Two leaves of brick or blockwork, each typically 100 mm thick, separated by a cavity and coupled by butterfly wall ties.

Dry-lined: Walls lined on both sides with a single layer of plasterboard, usually 9.5 mm thick, attached by dabs or battens.

Plastered: Walls plastered on both sides. No distinction is made between lightweight and traditional materials.

Concrete, autoclaved aerated: Walls built from autoclaved aerated concrete blockwork and having a surface mass below 250 kg/m^2.

Concrete, dense blockwork: Walls having a surface mass exceeding 415 kg/m^2.

Concrete dense: Solid walls built from large concrete panels or concrete poured in situ. Some examples had a plaster finish and some were fair-faced. The surface mass normally exceeds 415 kg/m^2.

Concrete, lightweight aggregate blockwork: This is a general term referring to blockwork containing various types of aggregate, including pulverised fuel ash, chemically stabilised graded wood particles and furnace clinker. The surface mass of walls built from such blocks, when plastered, normally exceeds 250 kg/m^2.

Concrete, no-fines: Solid walls plastered or rendered on both sides. The surface mass normally exceeds 415 kg/m^2.

Plasterboard on timber frame walls: Walls comprising two separate stud frames each supporting one leaf of the wall, each leaf being in the form of a laminate of plasterboard (or plasterboard and plywood) at least 32 mm thick, with the separation between the inner faces of the two leaves exceeding 200 mm and containing one or two sound-absorbing quilts over the whole area.

Table 1 Sound insulation performance of different constructions

Material	Type	Finish	Solid or cavity *(cavity width mm)*	Average AAD	Risk of failure to achieve stated AAD value *(Risk expressed as a percentage)*		
					23 dB AAD	48 dB AAD	80 dB AAD
Brickwork		DL	38 and wider	44	79	44	8.5
		DL	S	32	67	23	1.1
		P*	50 and wider	29	62	17	0.5
		P*	S	20	43	4.8	less than 0.1
Concrete: autoclaved aerated	Blockwork	DL	S	99	greater than 99	greater than 99	89
		P	50-70	67	92	72	35
		P	75 and wider	44	80	44	7.3
		P	S	49	82	49	14
Concrete: dense	Blockwork	DL	50 and wider	42	86	37	1.5
		P*	50 and wider	5	less than 0.1	less than 0.1	less than 0.1
		P*	S	13	14	less than 0.1	less than 0.1
Concrete: dense	Cast in situ or precast panels	F/P	S	7	1.4	less than 0.1	less than 0.1
Concrete: Lightweight aggregate	Blockwork	DL	50 and wider	42	77	41	7.2
		DL	S	44	83	43	5.2
		P	50-70	40	75	37	5.6
		P	75 and wider	41	81	37	3.1
		P	S	30	64	17	0.4
Concrete: no-fines	Cast in situ	P	S	13	25	0.8	less than 0.1
Plasterboard	Timber frame	—	200 and wider	6	less than 0.1	less than 0.1	less than 0.1

DL = dry lined
P = plastered
F/P = fair faced or plastered

* Samples restricted to party walls associated with external flanking walls which met, or were close to, deemed to satisfy requirements.

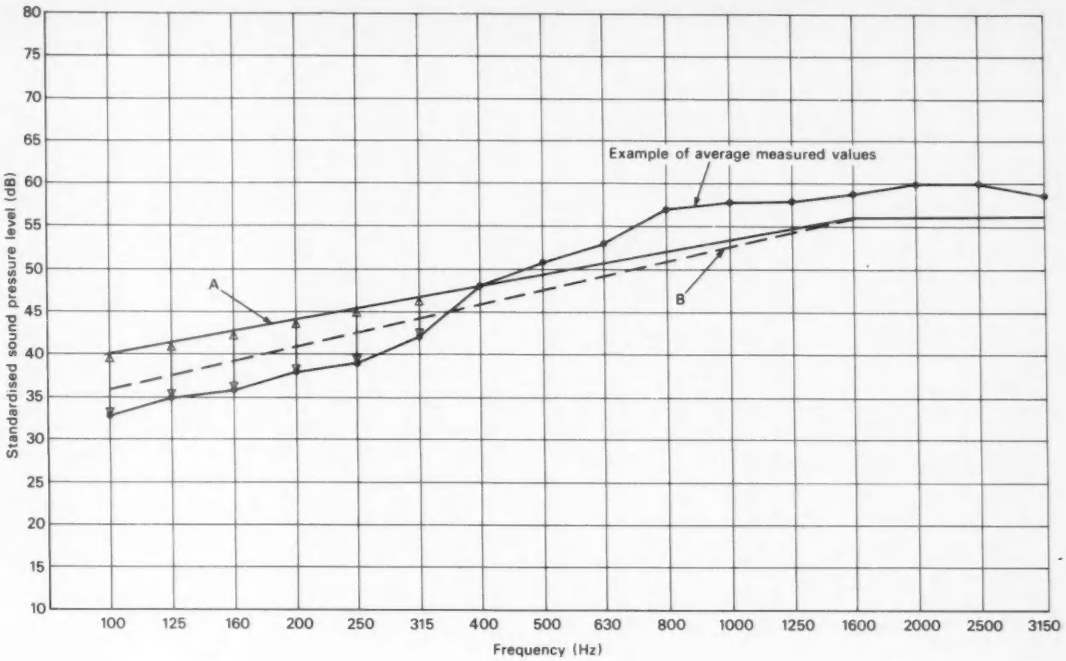

Fig 1 Example of calculaton of AAD
In the example shown the AAD related to Curve A is: 7 + 6 + 7 + 6 + 6 + 5 = 37 dB

The average AAD found for each type of construction is shown in Table 1. It is clear that the performance of a particular type of construction cannot be specified adequately by a single AAD value; this is because of the wide range of performance found for most types of construction. With present experience, variability must be regarded as an inherent feature of sound insulation performance. Some factors which may help to prevent bad performance are discussed later, but in general the causes of variability are not fully understood. Therefore, when assessing the suitability of a possible type of construction, it is prudent to consider the risk of failing to achieve various levels of performance. For example, only for six of the types listed in Table 1 is the risk of failure to achieve 23 dB AAD less than 50 per cent. For these same six types the risk of failure to achieve 48 dB AAD and 80 dB AAD are less than 5 and 0.1 per cent respectively.

The table has been prepared from data on individual walls, not groups of four. The values shown in the last three columns are best estimates, based on the means and standard deviations of the samples measured in the survey. Because of statistical uncertainties in the estimated values, small differences have little practical significance.

The table highlights the following points:

With masonry walls, mass is the main factor determining performance.

Lightweight constructions comprising two leaves of plasterboard on studwork (described in Digest 187) can provide a high standard of insulation. From the survey evidence, this construction seems to be reliable.

Solid and cavity versions of the same type of masonry wall usually provide fairly similar performance. Consequently there is little advantage for sound insulation in using cavity construction for masonry walls.

Plastered walls usually provide better performance than their dry-lined counter-parts. The difference depends on the wall type and is small for cavity lightweight aggregate blockwork walls but large for cavity dense blockwork walls. The dry-lined walls in the sample generally were not rendered. It is not known if rendering before dry-lining affects performance.

Factors affecting performance

The tabulated results are for typical constructions with no evidence of major faults. Even designs which normally provide adequate insulation may give poor results if such faults are present and so particular attention should be paid to the following details to avoid the more common faults:

Direct air paths through or round a party wall, even in the roof space, should be kept to a minimum by use of joist hangers where necessary and by careful sealing around any unavoidable penetrations of the wall. To reduce the risk of penetration, flush mounting fittings should not be attached back-to-back on the party walls, but separated by at least 200 mm. It is essential to make a wall airtight; even gaps having a total area of only 100 mm^2 in a 10 m^2 wall (0.001 per cent) may be sufficient to seriously limit performance, particularly at high frequencies.

Ceilings in upper-floor rooms should be of plasterboard or other airtight material of similar mass. Several examples of poor insulation have been found between bedrooms with lightweight ceilings.

It is advisable to continue the party wall construction, unmodified, right through the roof space. With cavity walls it is particularly important not to close the cavity with blocks supported on both leaves to form a base for a single leaf extension in the roof space.

A masonry party wall should be bonded to the inner or only leaf of the external masonry wall and not merely butt jointed.

Resilient thermal insulating materials (such as expanded polystyrene) which are attached to the flanking walls then plastered over may reduce the sound insulation. An adverse effect has also been found from wood-wool slabs used as permanent shuttering for concrete.

Minimum connections should be used between the leaves of cavity party walls consistent with structural stability. If, for structural reasons, butterfly wire ties cannot be used, it is better to use a solid wall of the required mass.

Air bricks and windows in adjacent dwellings should be separated by at least the minimum distance (690 mm) specified in the Building Regulations to minimise transmission via air paths outside the building or along the wall cavity.

The mass of a brick wall is significantly higher if the bricks are laid 'frog up' and filled with mortar instead of 'frog down' and hence the sound insulation performance will be improved.

Room Layout

Generally, designs which minimise common wall area are beneficial for sound insulation. For example, a wall will provide better sound insulation where it separates two rectangular rooms by forming one of the shorter dimensions rather than one of the longer dimensions. Similarly, stepped or staggered layouts between dwellings tend to improve performance. This applies mainly to airborne sounds, such as conversation or music. However, occupants are often disturbed by 'structure borne' sounds such as plumbing noises, kitchen activities, footsteps on stairs and banging doors. It is generally preferable to arrange for rooms of similar function to be juxtaposed at the party wall and to be vertically in line in blocks of flats.

Further reading

BRE Digests

143 Sound insulation: basic principles

187 Sound insulation of lightweight dwellings

BRE Current Papers

SEWELL, E C, and SCHOLES, W E. Sound insulation performance between dwellings built in the early 1970s. CP 20/78.

SEWELL, E C, and ALPHEY, R S. Field measurements of the sound insulation of party walls in timber-framed dwellings. CP 39/77.

SEWELL, E C, and ALPHEY, R S. Field measurements of the sound insulation of heavy solid concrete party walls. CP 43/77.

SEWELL, E C, and ALPHEY, R S. Field measurements of the sound insulation of plastered solid brick walls. CP 37/78.

SEWELL, E C, ALPHEY, R S, SAVAGE, J E, and FLYNN, S J. Field measurements of the sound insulation of plastered cavity masonry walls. CP 4/80.

SEWELL, E C, ALPHEY, R S, SAVAGE, J E, and FLYNN, S J. Field measurements of the sound insulation of plastered solid blockwork walls. CP 5/80.

SEWELL, E C, ALPHEY, R S, SAVAGE, J E, and FLYNN S J. Field measurements of the sound insulation of dry-lined masonry party walls. CP 6/80.

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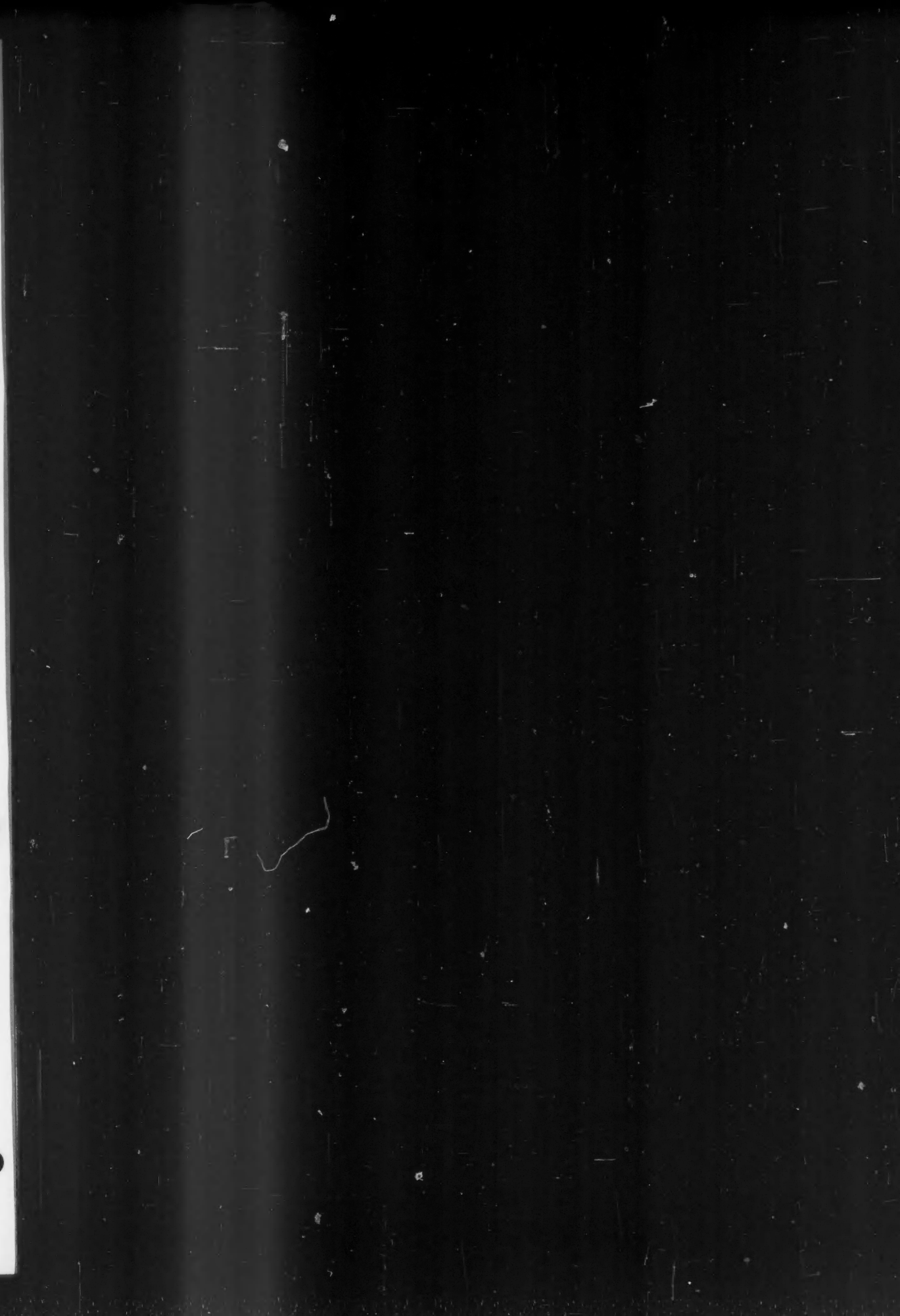
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